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DIABETES:

The Burden in Montana

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EXECUTIVE SUMMARY

Prevalence of Diabetes has increased in Montana.

- Almost 48,000 adults in Montana have diagnosed diabetes —6.4 percent of adults.
- The rate has been increasing steadily from 2.8 percent in 1990.
- The rate of diabetes in American Indians is 2.5 times higher than the rate in the general population and has also increased.

Cardiometabolic Risk Factors are common in those at-risk for diabetes and heart disease.

- Twenty-one percent of all adults were obese according to their reported height and weight.
- Thirty percent of adults without diabetes reported high cholesterol levels.
- Twenty-two percent of adults without diabetes reported high blood pressure.
- Persons with diabetes reported high cholesterol and high blood pressure at least twice as frequently as those without diabetes.

Diabetes in Pregnancy is an additional public health burden.

- Almost 3 % of all births listed some form of diabetes with gestational diabetes listed as the major form.
- Montana Indian women had twice the rate of diabetes in pregnancy compared to whites.
- Women with a history of gestational diabetes were twice as likely to have pregnancy related diabetes in a subsequent pregnancy up to five years later compared to women without gestational diabetes.

Diabetes Care is comprehensive.

- Sixty percent of Montana adults with diabetes reported receiving diabetes education classes, and 67 percent monitored their blood sugar at least daily.
- Sixty- seven percent had received A1c testing twice in the past year; 72 percent an annual eye exam, and 80 percent an annual foot exam.
- Two-thirds were currently immunized with a yearly flu shot and one pneumovax.

Diabetes Complications are widespread.

- Hospital discharge rates for diabetes increased in recent years to 136 per 10,000.
- Diabetes contributed to 45 percent of new and existing ESRD in Montana and 66 percent of non-traumatic lower extremity amputations.
- Hospital discharge rates for stroke and heart disease with diabetes in Montana were lower than comparable US rates.

Diabetes Mortality is higher in Montana Indians compared to whites.

- The age-adjusted diabetes mortality rate was 23 per 100,000 with rates in Montana Indians three times higher than that of non-Indians.

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INTRODUCTION

Diabetes

Diabetes is complex chronic metabolic disorder characterized by high blood sugar which, in its various forms, can affect people of all ages. The progressive complications of diabetes include blindness, amputation, kidney failure and nerve problems.[1] Diabetes markedly increases the risk of heart disease and stroke.[1] Type 1 diabetes, generally diagnosed during childhood or adolescence, is an autoimmune disease where the immune system destroys insulin-making cells of the pancreas. Type 1 diabetes makes up about 5 percent of the overall burden of diabetes.[2] The much more common form is type 2 diabetes which is associated with obesity and insulin resistance. Type 2 diabetes is most frequently diagnosed during adulthood and contributes to 90 to 95 percent of the diabetes burden.[2] Type 2 diabetes is highly prevalent in certain populations including American Indians. With increasing rates of obesity in the US, type 2 diabetes is now being diagnosed in children and adolescents.

Diabetes in pregnancy is also a serious and growing challenge. High blood sugars from pre-existing diabetes of either type are associated with serious congenital malformations. Gestational diabetes can develop during pregnancy but resolve after delivery.[3] Any form of diabetes in pregnancy is associated with obstetrical complications at delivery and potential problems for the newborn. Women who develop gestational diabetes are at very high risk of developing type 2 diabetes postpartum, and children from any diabetic pregnancy are at risk for obesity and type 2 diabetes at a young age.[4,5] Thus, diabetes and its complications present a major clinical and public health challenge, and preventing type 2 diabetes through diet and exercise has become an urgent priority for many communities.[6]

INTRODUCTION

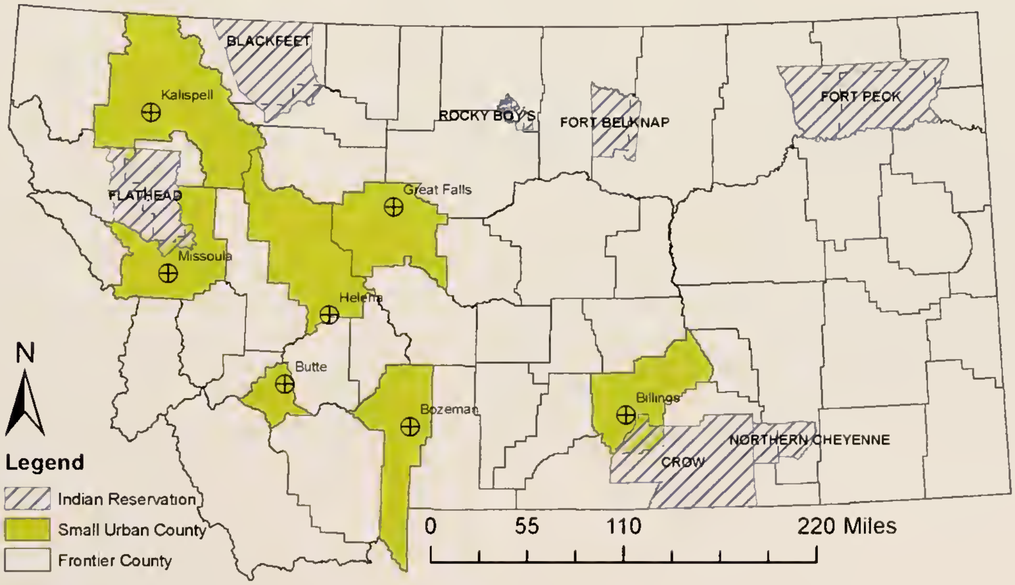
Montana

Montana is the fourth largest state in the nation with a land area of 145,552 square miles and is among the most rural. The most recent estimate (2006) of Montana's total population is 944,632, resulting in a population density of just over six persons per square mile.[7] The majority of the state's population resides in western Montana, with the notable exception of Yellowstone County. The population density of western Montana is 12 persons per square mile compared to 4 persons per square mile in eastern Montana. Forty-nine of Montana's 56 counties are classified as frontier counties.[8] Seven counties are classified as small urban counties — 62 percent of Montana's population reside in one of these counties.

The median age is 39.5 years and 14 percent of Montana residents are 65 years of age or older.[9] Over 90 percent of Montana's population is white. American Indians comprise 6.8 percent of Montana's population and are the state's largest minority group.[9] Montana has 7 American Indian reservations and 12 tribes are formally represented in the sovereign tribal governments on these reservation.

Montana is also one of the poorest states in the nation. Montana ranked 44th in the nation in 2006 with a median household income of $39,821 — 17 percent less than the US median household income ($48,201).[10] In terms of wages, in 2003, eight of the ten poorest counties in America were located in Montana's frontier counties.[11] In 2006, the Behavioral Risk Factor Surveillance System (BRFSS) found that 17 percent of all Montanans reported having no health care coverage. Uninsured adult Montanans were likely to be younger and report lower income and less education than adults with health care coverage (data not shown).[12]

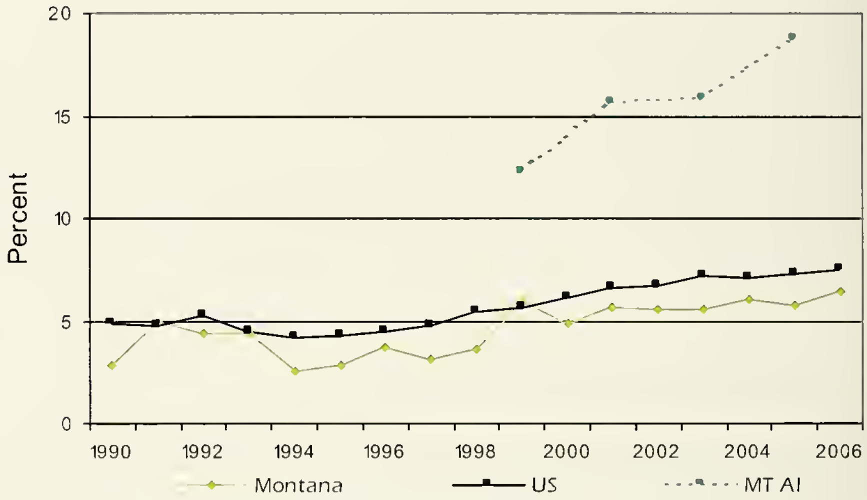
Figure I-1: American Indian reservations and small urban counties in Montana.



PREVALENCE

Since 1990, diabetes prevalence in the US and Montana has continued to rise. In 2006, 6.4 percent of Montana adults reported having diabetes—about 48,000 adults. The prevalence of diabetes in adults in Montana increased from 2.8 percent in 1990 to 6.4 percent in 2006. In the United States, the prevalence of diabetes was slightly higher than the rate in Montana, and the US rates also increased from 4.9 percent in 1990 to 7.5 percent in 2006. (Figure 1-1)

Figure 1-1. Prevalence of diabetes for all Montanans, Montana Indians and the US, 1990 to 2006.



Data source: Montana BRFSS, Montana DPHHS, Health Planning Section, 1990-2006.
Montana American Indian adapted-BRFSS, Montana DPHHS, 1999, 2001, 2003 and 2005.
*Question changed in 1994 to exclude females with gestational diabetes.

Risk Factors for Diabetes

Race

In 2005, 18.7 percent of Montana Indian adults (about 10,000) reported a diagnosis of diabetes; about 2.5 times greater than the general Montana population. From 2000 to 2005, prevalent diabetes increased about 50 percent in Montana Indians from 12.2 percent in 1999 to18.7 percent in 2005. Though American Indians represent only 6.8 percent of the Montana population, they contributed about 25 percent of prevalent diabetes cases in 2005.

Age

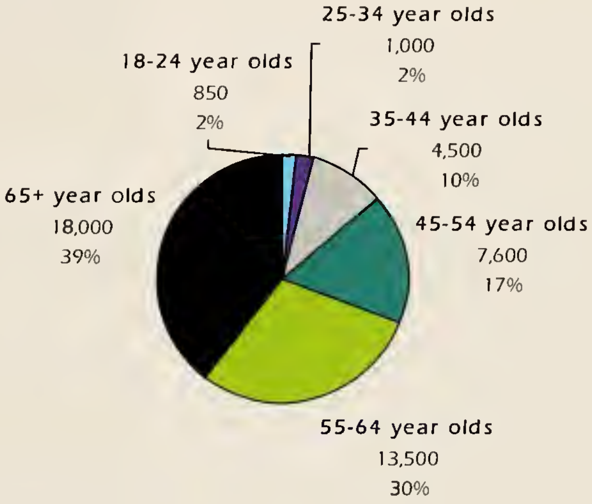
The prevalence of diabetes increases with increasing age. For 2006, estimated prevalence of diabetes in the youngest adult age groups, 18 to 24 and 25 to 34 year old, was 0.9 percent [95% CI: 0—2.2] in both. About 4 percent (3.7 [2.2-5.2]) of adults aged 35 to 44 and 5.5 [3.7-7.3] percent of adults aged 45 to 54 had diabetes. Diabetes prevalence was twice as high (11.7 [9.6-13.8]) in those aged 55 to 64 years of age and was highest (14.0 [12.0-16.0]) in adults over 65 years in age.

From 1995 to 2006, the prevalence of diabetes in the youngest adult age groups remained at about 0.9 percent. Prevalence in the oldest three age groups, 45 to 54 years old, 55 to 64 years old and greater than 65 years old doubled between 1996 and 2001. The prevalence in the 45 to 54 and the 55 to 64 year old age groups has remained constant in the most recent years. However, since 2003, the prevalence in persons greater than 65 years of age continued to increase. Prevalence in 35 to 44 year olds also doubled, increasing from 1.7 percent [0.5-2.9] in 1999 to 3.3 percent [2.0-4.6] in 2004, but remaining at about 3.3 percent in 2005 and 2006. (Data not shown)

PREVALENCE

Diabetes occurs commonly in the middle aged or elderly. Adults over 45 years of age comprised 86 percent of the burden of diabetes in Montana in 2006. Middle aged people, those 45 to 64 years old, accounted for 47 percent of the diabetes burden, while the elderly (65 years or older) accounted for 39 percent. (Figure 1-2)

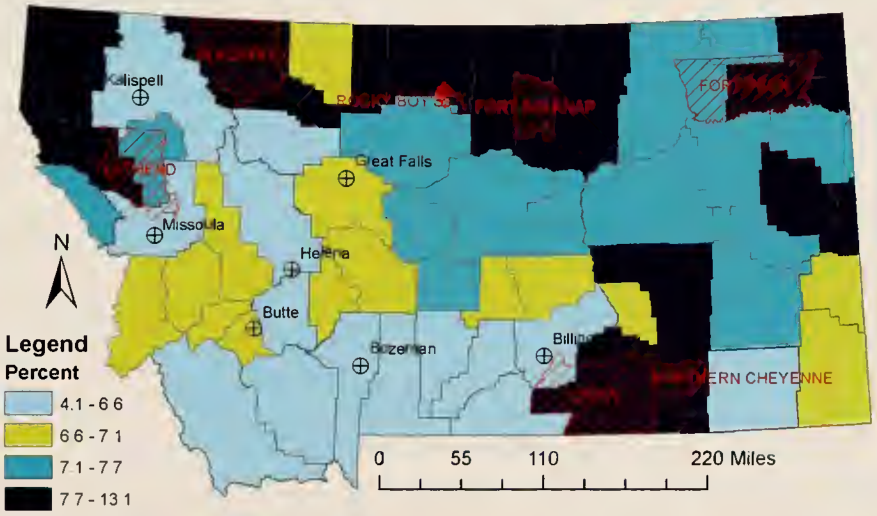
Figure 1-2. Percentage of persons with diabetes from each adult age group. Montana 2006.



County of Residence

In 2005, there was a strong association between diabetes prevalence and the county of residence. Counties with the lowest diabetes prevalence tended to cluster along the mountain ranges in western Montana. All of the counties containing major population centers were among the lowest diabetes prevalence. Counties in eastern Montana tended to have higher prevalence of diabetes. With a few exceptions, counties with the highest diabetes prevalence included an Indian reservation. (Figure 1-3)[13]

Figure 1-3. County Level Estimates of Diabetes Prevalence -- Percentage of Adults in Montana by Quartiles, 2005



CARDIOMETABOLIC RISK FACTORS

2

Metabolic Syndrome is defined as a clustering of risk factors that confer an increased risk for cardiovascular disease. These risk factors include: abdominal obesity, elevated blood sugar, high triglyceride levels, low HDL and high blood pressure. Individuals with Metabolic Syndrome, whose blood sugar values are not in the diabetic range, are also known to be at very high risk for type 2 diabetes.[14] Thus the term cardiometabolic risk encompasses a set of risk factors for both type 2 diabetes and cardiovascular disease stemming from obesity and insulin resistance. Most importantly, intensive lifestyle intervention can have independent and beneficial effects on each risk factor thus reducing the risks of type 2 diabetes and cardiovascular disease.[15]

Reducing cardiometabolic risk factors is an important clinical and public health challenge in Montana. There is a higher prevalence of obesity, high cholesterol and high blood pressure in people with diabetes than in people without diabetes, contributing to the increased risk of cardiovascular disease in people with diabetes. And many Montanans who are overweight, hypertensive and have dyslipidemia are at risk for type 2 diabetes.

Table 2-1: ATP 2I Clinical Identification of the Metabolic Syndrome[14]

Risk Factor	Defining level
Abdominal obesity, given as a waist circumference	
Men	≥ 40 in (≥ 102 cm)
Women	≥ 35 in (≥ 88 cm)
HDL cholesterol	
Men	<40 mg/dL
Women	<50 mg/dL
Triglycerides	≥ 150 mg/dL
Fasting glucose	≥ 100 mg/dL
Blood pressure	Systolic ≥ 130 mm Hg Diastolic ≥ 85 mm Hg

Table 2-2: Weight categories by body mass index (BMI)

	BMI range
Normal	18-24.9 kg/m^2
Overweight	25-29.9 kg/m^2
Obese	≥ 30 kg/m^2
Clinically obese	35-39.9 kg/m^2
Morbidly obese	≥ 40 kg/m^2

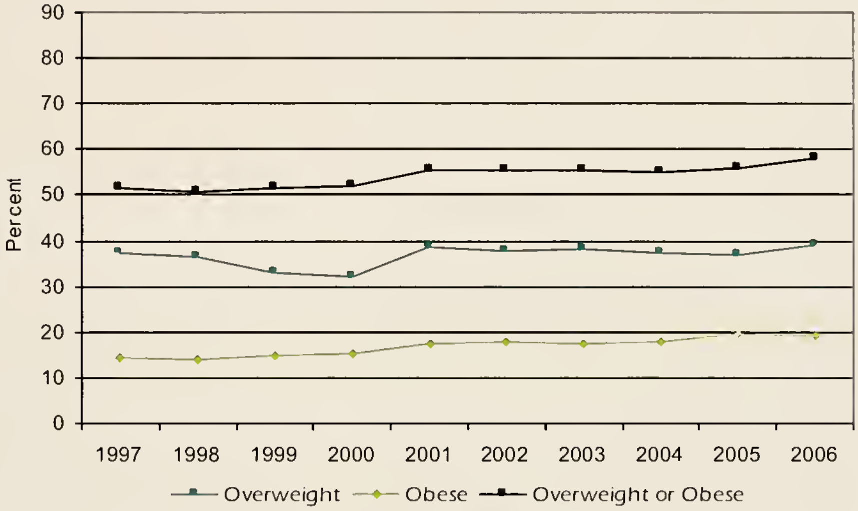
CARDIOMETABOLIC RISK FACTORS

Overweight and Obesity

Overweight and obese individuals are at increased risk of developing type 2 diabetes, high cholesterol and high blood pressure. In 2006, 21 percent of all Montana adults were obese. Thirty-eight percent of Montana Indians were obese, almost twice the state prevalence.

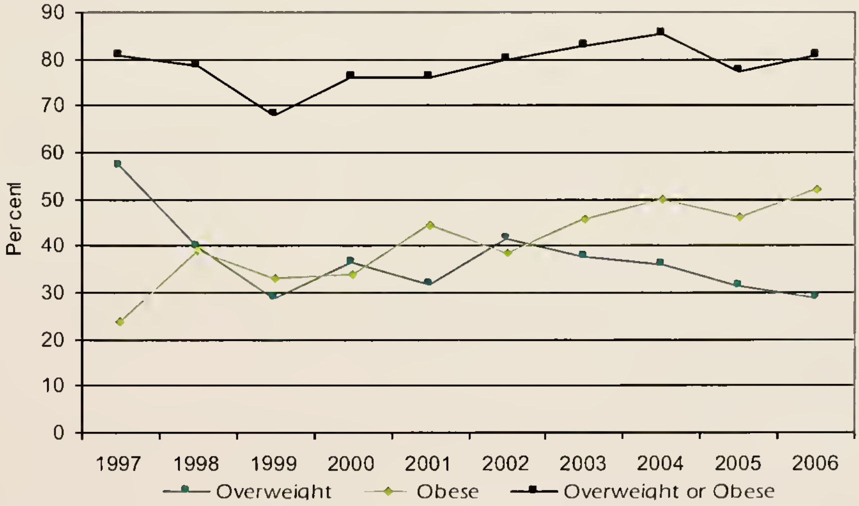
For people with diabetes, the percent who were overweight or obese remained at about 80 percent for the time period 1997 to 2006. The percent overweight decreased from a high of 57 percent [95% CI: 44-69%] in 1997 to 29 percent [24-34%] in 2006. The percentage of obese people with diabetes increased from a low of 24 percent [14-37%] in 1997 to 52 percent [46-57%] in 2006. (Figure 2-2) The average body mass index of a person with diabetes in 2006 (35.0 kg/m^2) was higher than in 1997 (30.1 kg/m^2). Additionally, a greater percentage of obese people with diabetes were morbidly obese in 2006 compared to 1997 (20 percent versus 10 percent).

Figure 2-1. Prevalence of overweight and obesity among Montanans without diabetes, 1997 to 2006.



Data source: Montana BRFSS, Montana DPHHS, Health Planning Section, 1997-2006.

Figure 2-2. Prevalence of overweight and obesity among Montanans with diabetes, 1997 to 2006.



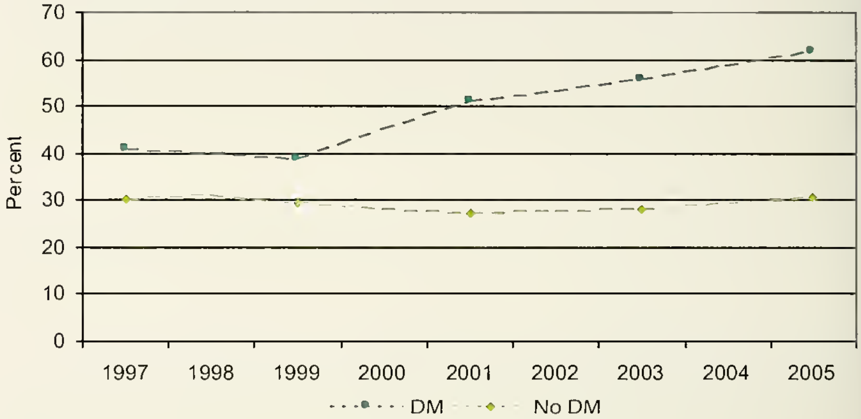
Data source: Montana BRFSS, Montana DPHHS, Health Planning Section, 1997-2006.

CARDIOMETABOLIC RISK FACTORS

High Cholesterol

The prevalence of high cholesterol was higher among people with diabetes as compared to people without diabetes. The prevalence of high cholesterol reported by people with diabetes in 2005 was 62 percent [95% CI: 55-68%]. From 1997 to 2005 the prevalence of high cholesterol reported by people without diabetes remained at approximately 30 percent. However, the prevalence of high cholesterol among those with diabetes increased from 41 percent [28-55%] in 1997 to 62 percent in 2005, with the sharpest increase occurring between 1999 and 2001. (Figure 2-3)

Figure 2-3. Prevalence of high cholesterol by diabetes status, Montana 1997 to 2005.

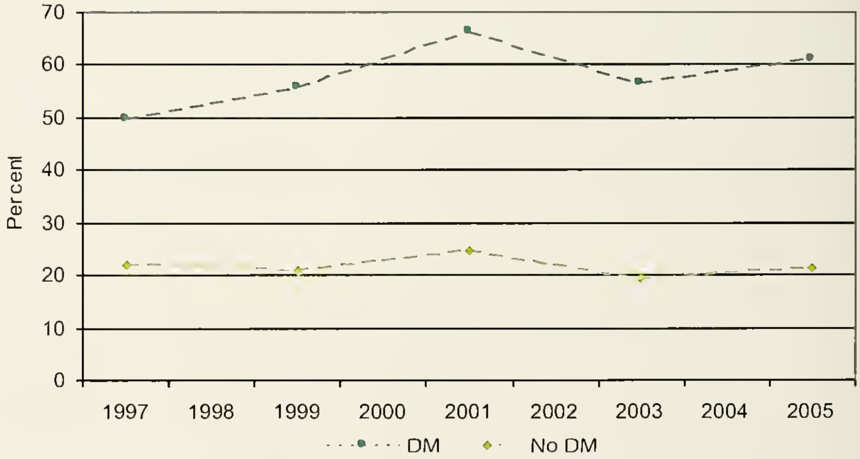


Data source: Montana BRFSS, Montana DPHHS, Health Planning Section, 1997-2006.
High cholesterol not queried in 1998, 2000, 2002 and 2004 for Montana.

High Blood Pressure

People with diabetes also reported a greater prevalence of high blood pressure when compared to people without diabetes. In 2005, the prevalence of high blood pressure among people with diabetes was 61 percent [54-68%], increasing about 12 percentage points from 49 percent [37-63%] in 1997. The prevalence of high blood pressure among people without diabetes remained at about 22 percent from 1997 to 2005. (Figure 2-4)

Figure 2-4. Prevalence of high blood pressure by diabetes status, Montana 1997 to 2005.



Data source: Montana BRFSS, Montana DPHHS, Health Planning Section, 1997-2006.
High blood pressure not queried in 1998, 2000, 2002 and 2004 for Montana.

3

DIABETES DURING PREGNANCY

Diabetes during pregnancy includes both gestational diabetes and pre-existing diabetes. Gestational diabetes is defined as diabetes first diagnosed during pregnancy; after delivery, a woman's glucose tolerance may return to normal, but the woman is at high risk for subsequently developing diabetes.[3] Pre-existing diabetes includes either type I or type 2 diabetes present before conception. All forms of diabetes during pregnancy are associated with complications during labor and delivery and adverse fetal outcomes.

Montana birth certificates currently use a check box system to indicate if a pregnancy is affected by gestational or pre-existing diabetes. However, before 2000, Montana birth certificates did not reliably differentiate between gestational and pre-existing diabetes.

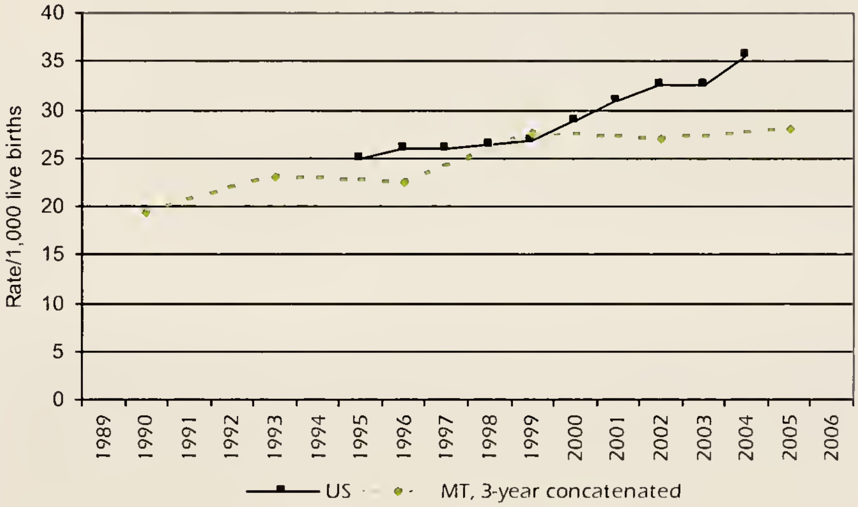
Prevalence

The prevalence of any form of diabetes during pregnancy for the time period 2004 to 2006 was 2.8 percent of live births; about 300 births per year. Most of these pregnancies were affected by gestational diabetes (2.3 percent); 0.5 percent were attributed to pre-existing diabetes. The prevalence recorded in Montana is less than the US prevalence, estimated at about 4 percent of live births.[16]

The most recent estimates of the prevalence rates of gestational and pre-existing diabetes in Montana were 26 and 5 per 1,000 live births, respectively.

The rate of diabetes in pregnancy in Montana has increased over the past 17 years, but more slowly than the US rate. In Montana, the rate of diabetes during pregnancy increased 27 percent between 1995 and 2006, from 22 to 28 per 1,000 live births. The U.S. rate increased 44 percent between 1995 and 2004, from 26 to 36 per 1,000 live births. (Figure 3-1)[17]

Figure 3-1. Rate of diabetes during pregnancy in Montana and the US, 1989 to 2006.



Data Source: Montana birth certificates, Montana DPHHS, Vital Statistics Dept.1989 - 2006.
US: USDHHS, CDC, NCHS, Division of Vital Statistics. 1995-2004.

DIABETES DURING PREGNANCY

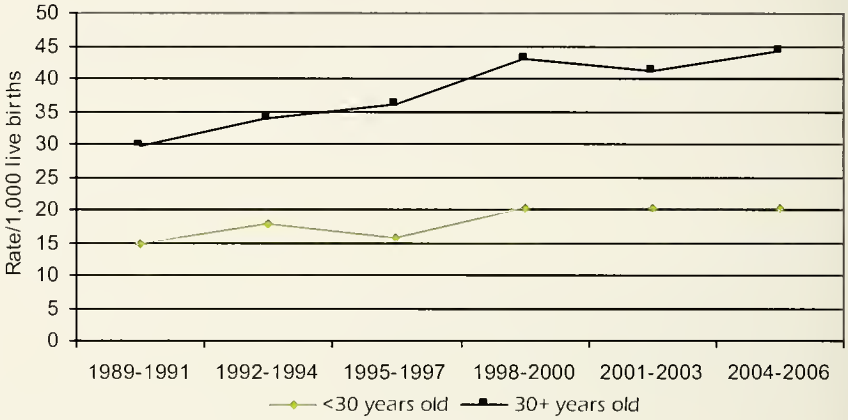
Risk Factors for Diabetes during Pregnancy

Age

Older mothers (30 years or older) had a higher rate of both gestational and pre-existing diabetes during pregnancy than younger women.

The rate of diabetes during pregnancy increased in mothers of all ages. However, the rate in older mothers increased faster than the rate in mothers less than 30 years of age. From 1989 to 2006, the rate of diabetes during pregnancy increased 33 percent for mothers less than 30 years of age. The rate increased 46 percent for older mothers, with the bulk of this increase occurring before 2000. (Figure 3-2)

Figure 3-2. Rate of diabetes during pregnancy by maternal age, Montana 1989 to 2006.



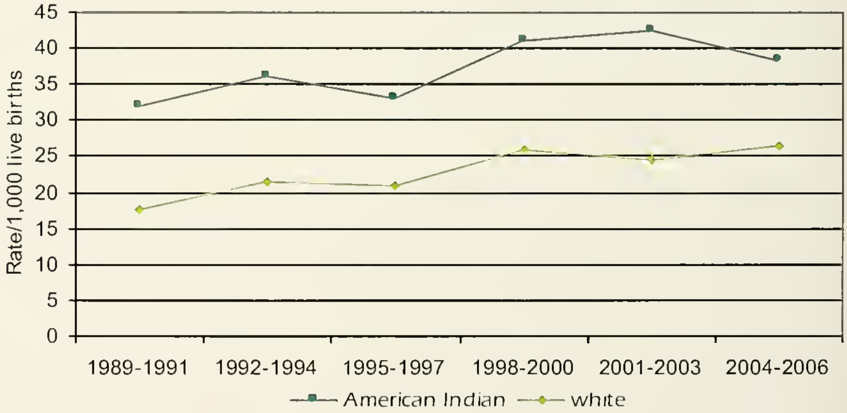
Data Source: Montana birth certificates, Montana DPHHS, Vital Statistics Dept. 1989 - 2006

Older mothers had a 7.6 times greater risk of having any form of diabetes during pregnancy when compared to mothers less than 20 years old (OR: 7.58 [5.08-11.72]†).

Race

American Indian women had almost twice the rate of diabetes during pregnancy compared to white women in Montana. Montana Indian women had a 67 percent greater risk of having diabetes during pregnancy compared to white women (OR: 1.67 [1.38-2.02]†). Over time, diabetes during pregnancy increased at the same rate for both Montana Indian and white women. (Figure 3-3)

Figure 3-3. Rate of diabetes during pregnancy by race, Montana 1989 to 2006.



Data Source: Montana birth certificates, Montana DPHHS, Vital Statistics Dept. 1989 - 2006

For women at high risk for diabetes during pregnancy because of age and race, the rate increased dramatically. For the time period 2004 to 2006, the rate of diabetes in pregnancy in Montana Indian women aged 30 years or older was 97 per 1,000 live births. This rate was 2.4 times the rate of white women of the same age and 3.6 times the rate of younger Indian women.

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† adjusted for age, race, parity, weight gain, education, geography and number of prenatal care visits

County of Residence

Women living in a frontier county had a 33 percent greater risk of having diabetes during pregnancy compared to women living in a small urban county (OR: 1.33 [1.16-1.53]†).

With the exception of Lewis & Clark County, counties containing one of the seven major population centers had lower rates of diabetes in pregnancy than frontier counties. Region 1, comprising most of eastern Montana, had the highest rate of diabetes in pregnancy. This region does not contain any major population centers, but encompasses three Indian reservations. (Figure 3-4)

Socioeconomic status

A mother enrolled in Medicaid in 2006 had a 43 percent greater risk of having diabetes during pregnancy than a mother not enrolled in Medicaid. If she was also a high-risk age, race or frontier county resident, her risk was multiplied. (Table 3-1)

Having gestational diabetes in a previous pregnancy

Women who had a previous pregnancy affected by gestational diabetes were twice as likely to have diabetes in a subsequent pregnancy compared to women who did not have gestational diabetes in a prior pregnancy.

Figure 3-4 Rate of diabetes in pregnancy by Montana Health Planning Regions and major population centers, 2000 to 2006

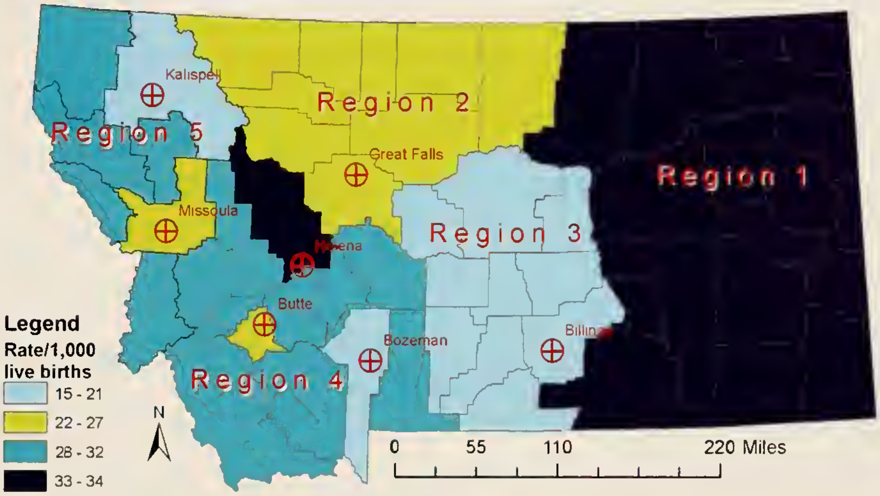

Table 3-1. Risk of diabetes during pregnancy in women enrolled in Medicaid, Montana 2006.

	Odds Ratio † [95% Confidence Interval]
No Medicaid, urban, white, <20 years old	Referent
Medicaid	1.43 [1.23-1.66]
Medicaid and lives in a frontier county	1.97 [1.71-2.27]
Medicaid and American Indian	2.36 [1.96-2.85]
Medicaid and 30+ years	10.80 [3.71-31.50]

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† adjusted for age, race, parity, weight gain, education, geography and number of prenatal care visits

4

CARE INDICATORS

Preventive diabetes care is essential to prevent or detect complications at an early stage to reduce morbidity and mortality. This chapter examines indicators of diabetes care reported by adults with diabetes through the Behavioral Risk Factor Surveillance System (BRFSS) and assesses progress in Montana toward the Healthy People 2010 goals.[18]

People with diabetes must manage their condition on a daily basis through proper diet, adequate exercise and regular monitoring of their blood glucose. Diabetes education helps individuals acquire the knowledge and skills to optimize control of their hyperglycemia and to seek regular preventive care including A1c testing to assess metabolic control. Annual foot exams can identify individuals at risk for foot ulcers or amputation at a time when education and preventive care can avert problems. Similarly, annual dilated eye exams are necessary to detect early signs of diabetic retinopathy. Early identification of kidney disease via testing for microalbuminuria and subsequent treatment can slow kidney disease progression. Because people with diabetes are particularly susceptible to infection, pneumococcal immunization and annual influenza vaccination are recommended.

☑ *Diabetes Education*

The Healthy People 2010 goal for diabetes education is 60 percent.[18]

In 2006, 60 percent of Montana adults with diabetes reported ever taking a class in how to self-manage their diabetes. Sixty-two percent of adults with diabetes reported attending a diabetes education class in 2000, and the percentage has remained about the same in recent years. Montana Indians had a similar prevalence of diabetes education, with about 54 percent receiving diabetes education from 2001 to 2005. The prevalence of diabetes education in the US was slightly lower (about 53 percent) over the same time period. (Figure 4-1)

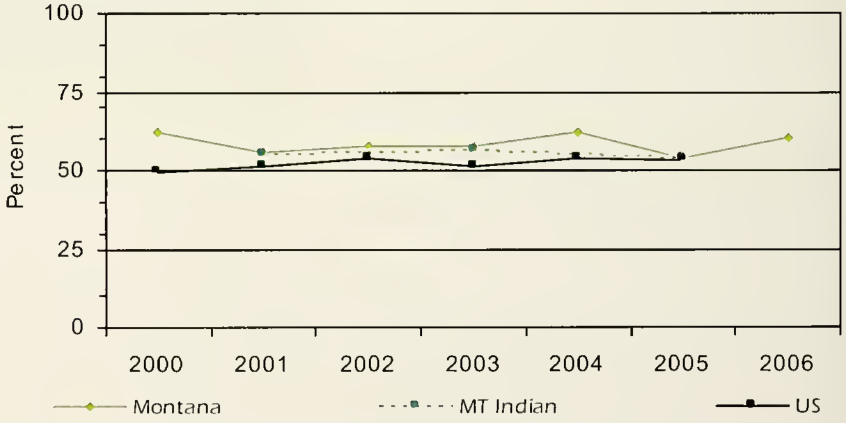
☑ *Self-monitoring blood glucose*

The Healthy People 2010 goal for daily blood glucose self-monitoring is 60 percent.[18]

Sixty-seven percent of Montana adults with diabetes reported monitoring their blood glucose at least once daily

☑ **Exceeds Healthy People 2010 goal**

Figure 4-1. Percentage of adults with diabetes who ever attended a diabetes course or class among all Montanans, Montana Indians and the general US population, 1999-2006

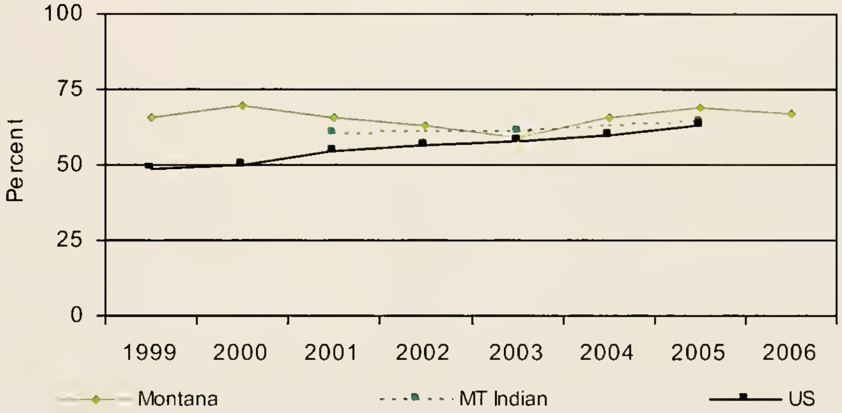


Data source: Montana BRFSS, Montana DPHHS, Health Planning Section, 2000-2006
Montana American Indian adapted-BRFSS, Montana DPHHS, 2001, 2003 and 2005
Values for the US population not available for 2005 and 2006

CARE INDICATORS

in 2006. Daily blood glucose monitoring practices reported by Montana Indians (65 percent) in 2005 were similar to those reported by Montana survey respondents overall and from the US (69 percent and 63 percent respectively). From 1999 to 2006, daily self monitoring prevalence among Montana residents remained above the Healthy People 2010 goal at approximately 65 percent. The trend in Montana Indians increased slightly from 60 percent in 2001 to 65 percent in 2005. The US prevalence increased from 49 percent in 1999 to 63 percent in 2005. (Fig 4-2). Only 7 percent of Montana adults (in 2006) and 8 percent of Montana Indians (in 2005) with diabetes reported they never monitored their blood glucose. (Data not shown).

Figure 4-2. Percentage of adults with diabetes who self monitor their blood glucose daily among all Montanans, Montana Indians and the general US population, 1999-2006

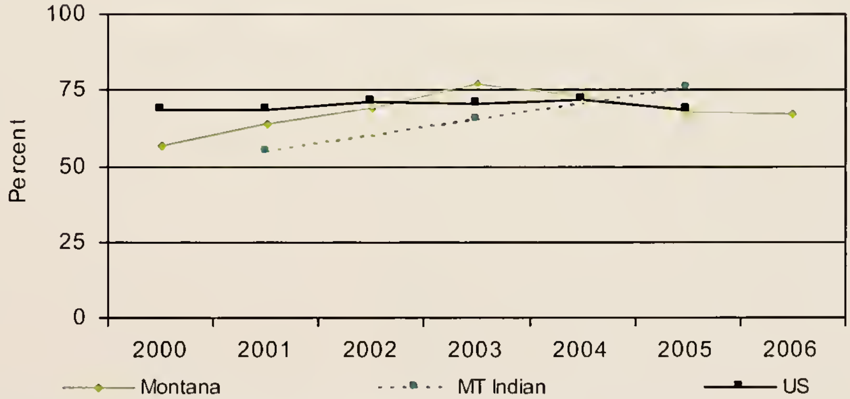


Data source: Montana BRFSS, Montana DPHHS, Health Planning Section, 1999-2006
Montana American Indian adapted-BRFSS, Montana DPHHS, 2001, 2003 and 2005
Values for the US population not available for 2005 and 2006

Hemoglobin A1c testing

The prevalence of bi-annual hemoglobin A1c testing in Montana in 2006 was 67percent. In 2005, the percent of adults reporting A1c testing at least bi-annually in the US was nearly identical to the percentage reported in Montana (69 percent and 68 percent, respectively). Montana Indians had a prevalence of A1c testing in 2005 of 76 percent. Prevalence of A1c testing in Montana Indians increased 20 percentage points from 55 percent in 2001 to 76 in 2005. The overall Montana prevalence increased from 64 percent in 2001 to a high of 77 percent in 2003 followed by a decrease to 68 percent in 2005. By contrast, over the same time period, the US prevalence remained at approximately 69 percent. (Figure 4-3) Thus rates of A1c testing in Montana exceed the Heath People 2010 goals for the US.

Figure 4-3. Percentage of adults with diabetes who had two or more A1c tests in the past year among all Montanans, Montana Indians and the general US population, 2000-2006



Data source: Montana BRFSS, Montana DPHHS, Health Planning Section, 2001-2006
Montana American Indian adapted-BRFSS, Montana DPHHS, 2001, 2003 and 2005
Values for the US population not available for 2005 and 2006

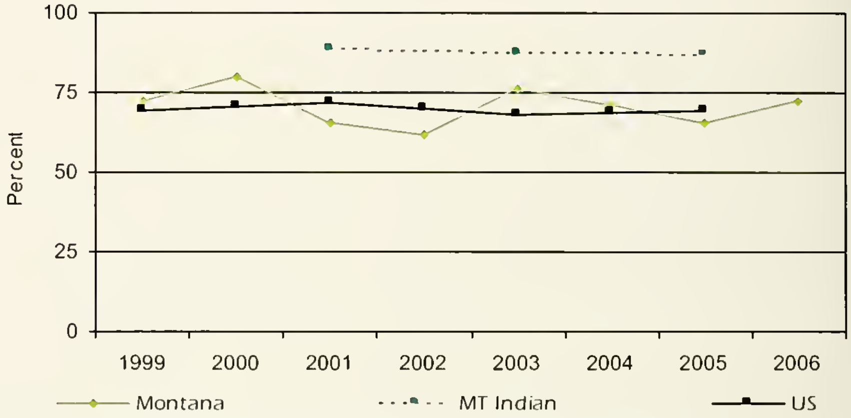
CARE INDICATORS

Annual Dilated Eye Exam

The Healthy People 2010 goal for annual dilated eye exams among adults with diabetes is 75 percent.[18]

In 2006, 72 percent of adults with diabetes reported receiving a dilated eye exam in the past twelve months. The Montana prevalence of annual dilated eye exams was similar to the US prevalence in 2005, 66 percent compared to 69 percent, respectively. The prevalence of annual dilated eye exams among Montana Indians was higher than the general Montana prevalence; 87 percent in 2005. Since 1999, annual dilated eye exam prevalence remained constant in all three populations – approximately 70 percent in the US and Montana and 87 percent in Montana Indians, slightly less than the Healthy People 2010 goal in all the populations except Montana Indians. (Figure 4-4)

Figure 4-4. Percentage of adults with diabetes who had an annual dilated eye exam among all Montanans, Montana Indians and the general US population, 1999-2006



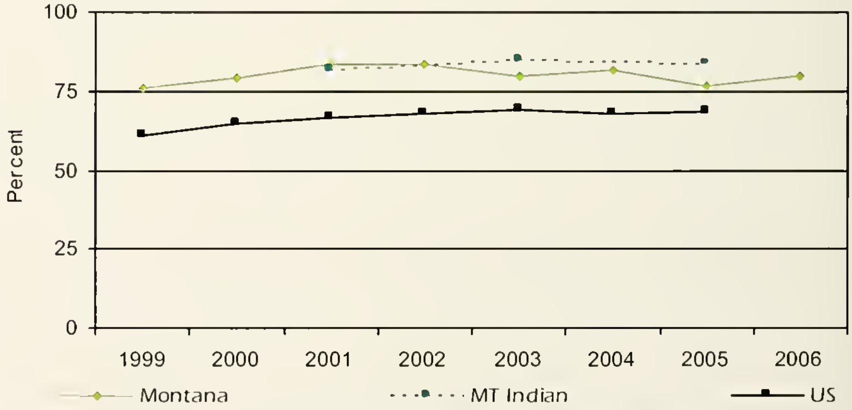
Data source: Montana BRFSS, Montana DPHHS, Health Planning Section, 1999-2006
Montana American Indian adapted-BRFSS, Montana DPHHS, 2001, 2003 and 2005
Values for the US population not available for 2005 and 2006

☑ *Annual Foot Exam*

The Healthy People 2010 goal for annual foot exams among adults with diabetes is 75 percent.[18]

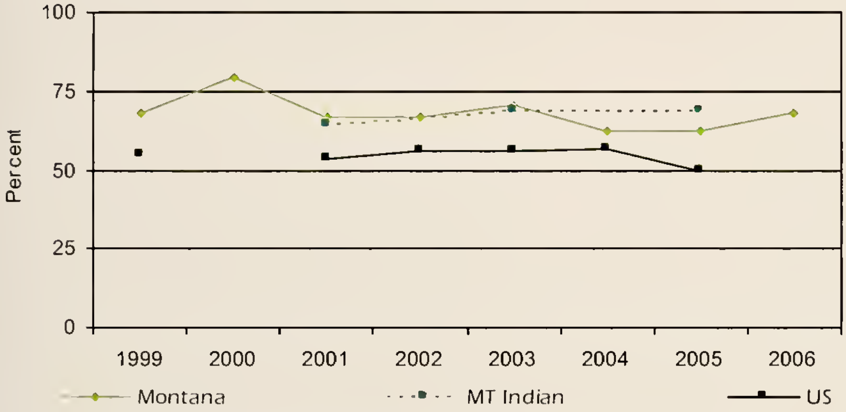
In 2006, 80 percent of adults with diabetes reported that a health care professional had checked their feet for sores at least annually. The prevalence of annual foot exam in 2005 among Montana Indians was 84 percent. Since 1999, the prevalence among Montana Indians and the general Montana population remained constant at approximately 84 and 80 percent respectively. By comparison, the US prevalence increased from 61 percent in 1999 to 69 percent in 2005. (Figure 4-5) Thus, the prevalence of foot exams

Figure 4-5. Percentage of adults with diabetes who had an annual foot exam among all Montanans, Montana Indians and the general US population, 1999-2006



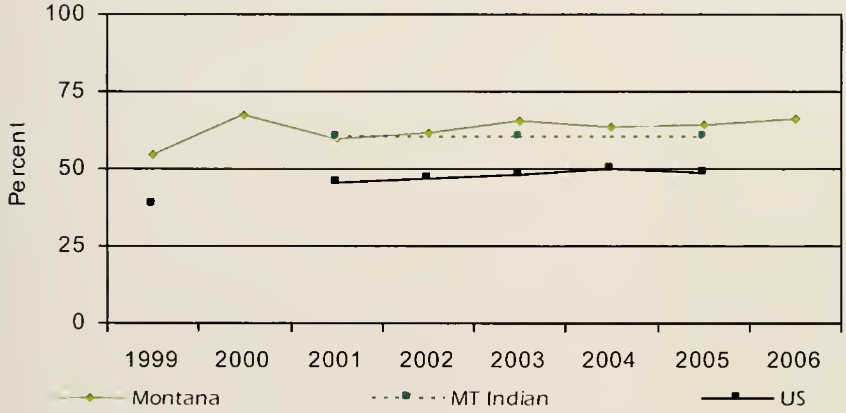
Data source: Montana BRFSS, Montana DPHHS, Health Planning Section, 1999-2006
Montana American Indian adapted-BRFSS, Montana DPHHS, 2001, 2003 and 2005
Values for the US population not available for 2005 and 2006

Figure 4-6. Percentage of adults with diabetes who had an annual influenza vaccination among all Montanans, Montana Indians and the general US population, 1999-2006



Data source: Montana BRFSS, Montana DPHHS, Health Planning Section, 1999-2006
Montana American Indian adapted-BRFSS, Montana DPHHS, 2001, 2003 and 2005
Values for the US population not available for 2000, 2005 and 2006

Figure 4-7. Percentage of adults with diabetes who ever had a pneumococcal vaccination among all Montanans, Montana Indians and the general US population, 1999-2006.



Data source: Montana BRFSS, Montana DPHHS, Health Planning Section, 1999-2006
Montana American Indian adapted-BRFSS, Montana DPHHS, 2001, 2003 and 2005
Values for the US population not available for 2000, 2005 and 2006

in Montana exceed the Healthy People 2010 goal set for the US.

Vaccination and Immunization

The Healthy People 2010 goals for annual influenza vaccinations and pneumococcal immunization in high risk individuals are both 60 percent.[18]

☑ *Annual Influenza Vaccination*

In Montana, the 2006 prevalence of influenza vaccination among adults with diabetes was 68 percent [95%CI: 62-73]. Montana consistently exceeded the Healthy People 2010 goal from 1999 to 2006, with an average prevalence of approximately 68 percent. The influenza vaccination prevalence in Montana Indians was similar to that of the general Montana population. In 2005, 69 percent of Montana Indian adults reported receiving an influenza vaccination in the last 12 months. The US influenza vaccination prevalence in 2005 was 50 percent. From 1999 to 2004, influenza vaccination prevalence in the US remained at approximately 55 percent. (Figure 4-6)

☑ Pneumococcal Vaccine Administration

In 2006, 66 percent [61-71] of Montana adults reported receiving a pneumococcal vaccine at least once. From 2000 to 2006, the prevalence of pneumococcal immunization in Montana remained at approximately 64 percent, just over the Healthy People 2010 goal. From 2001 to 2005, the prevalence of immunization against pneumococcal infection among Montana Indians re-

(Continued on page 17)

(Continued from page 16)

mained at the Healthy People 2010 goal of 60 percent. The US prevalence remained unchanged at 48 percent from 2001 to 2005. (Figure 4-7)

Thus, by 2006 prevalence of immunization for both influenza and pneumococcal infection reported by people with diabetes exceeded the Healthy People 2010 goals for high risk patients.

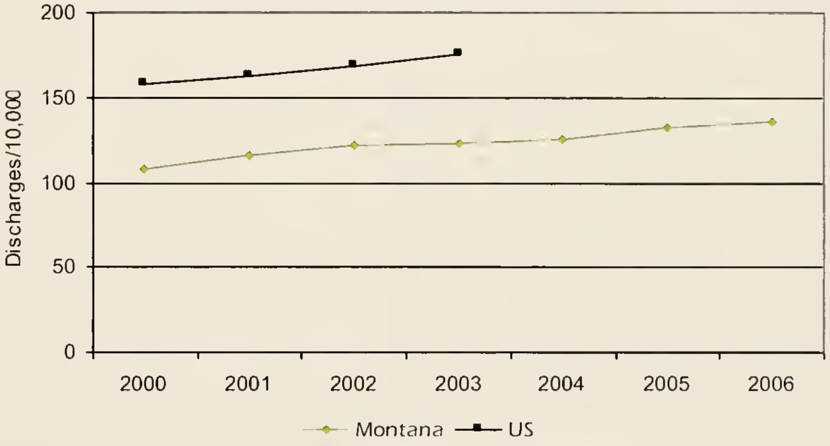
COMPLICATIONS

People with diabetes are at risk for a number of serious complications, including: kidney disease, cardiovascular disease, skin ulcers, infections, amputations, and eye problems (including blindness).[1] Complications related to diabetes are a result of complex metabolic disturbances secondary to hyperglycemia. Co-existing hypertension and/or dyslipidemia contribute to the development and exacerbation of these complications. Careful management of blood glucose levels, and treatment of hypertension and dyslipidemia can slow progression to diabetic complications.

Hospitalization

The age-adjusted hospital discharge rate in 2006 for any listed diagnosis of diabetes in Montana was 136 per 10,000. The rate of hospital discharges for diabetes increased steadily from 107 per 10,000 in 2000. The US hospital discharge rate was higher than the Montana discharge rate (122 per 10,000) in 2003. The US hospital discharge rate increased at a similar rate from 157 per 10,000 in 2000 to 176 per 10,000 in 2003. (Figure 5-1)

Figure 5-1. Age-adjusted hospital discharge rates per 10,000 for diabetes as any listed diagnosis for Montana and the general US population, 2000-2006.



Data source: MT: Montana hospital discharge data, Montana Hospital Association, 2000-2006.

Age

Most hospitalizations in adults with diabetes occurred in those aged 65 years and older. The hospital discharge rate for any listed diagnosis of diabetes in adults 65 years and older was 651 per 10,000 in 2006. This age group also had the greatest increase in hospitalizations from 527 per 10,000 in 2000. In contrast, hospital discharge rates for diabetes in those under 19 years of age remained at approximately 8 per 10,000 from 2000 to 2006. For the age group 20 to 44 year of age, hospital discharge rates from diabetes increased from 25 per 10,000 in 2000 to 45 per 10,000 in 2006. For middle aged people (45 to 64 years of age), hospital discharge rates for diabetes increased from 134 per 10,000 in 2000 to 160 per 10,000 in 2006. (Data not shown)

Most hospitalizations in adults with diabetes occur in the elderly

5

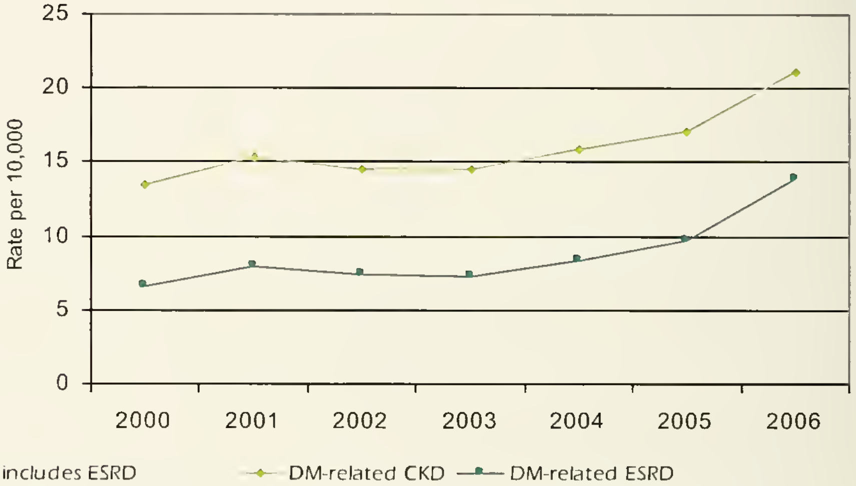
COMPLICATIONS

Chronic kidney disease and end-stage renal disease

The age-adjusted hospital discharge rate for chronic kidney disease (CKD) with a concurrent diabetes diagnosis was 21 per 10,000, in 2006. The age-adjusted hospital discharge rate for end-stage renal disease (ESRD) with a concurrent diabetes diagnosis was 14 per 10,000 (The CKD rate includes ESRD.) The trends for both CKD and ESRD discharge rates were flat at approximately 15 and 7 per 10,000, respectively, from 2000 to 2003. But from 2003 to 2006, CKD and ESRD discharge rates increased exponentially (Figure 5-2). This increase occurred primarily in persons 75 years of age and older and appeared to be related to an increase in heart failure hospitalizations in this group (Data not shown).

In 2005, 45 percent of all ESRD in Montana was attributed to diabetes. The percent of new cases attributed to diabetes in the US was similar to the percent in Montana, but the percent of existing diabetes-related ESRD in the US was lower (37 percent) compared to Montana (Table 5-1). The prevalence rate of diabetes-related ESRD in the US in 2005 (6 per 10,000) was higher than the Montana prevalence rate (4 per 10,000). ESRD prevalence rates in both the US and Montana have increased steadily from 2 per 10,000 in 1990. (Figure 5-3)

Figure 5-2. Age-adjusted hospital discharge rates for chronic kindey disease* or end-stage renal disease and diabetes as any diagnosis, Montana, 2000-2006.



*includes ESRD

Data source: MT: Montana hospital discharge data, Montana Hospital Association, 2000-2006.

Table 5-1: End-stage renal disease incidence and prevalence, Montana and the US, 2005

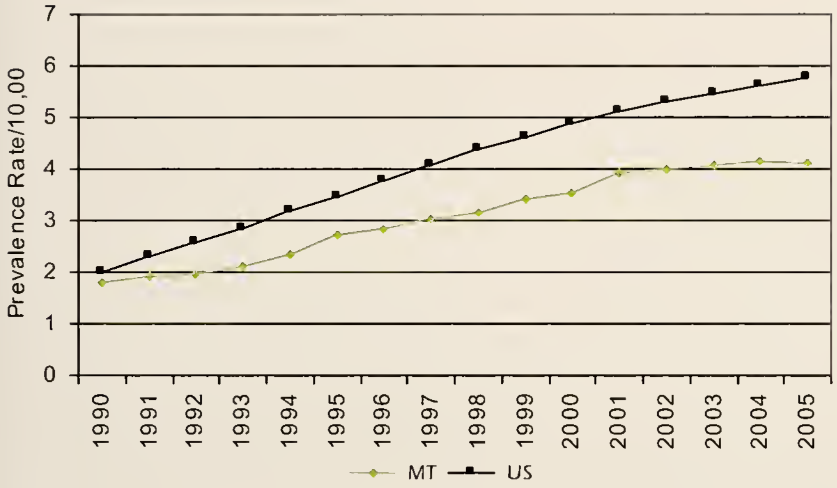
	Total number	Number due to diabetes	Percent due to diabetes
End-stage renal disease, Montana 2005			
New patients[1]	181	81	45%
Existing patients[2]	975	441	45%
End-stage renal disease, US 2005			
New patients[1]	104,767	45,905	44%
Existing patients[2]	477,583	176,429	37%

[1] New cases are persons first diagnosed with ESRD during 2005.

[2] Existing cases are persons living with ESRD as of 12/31/05

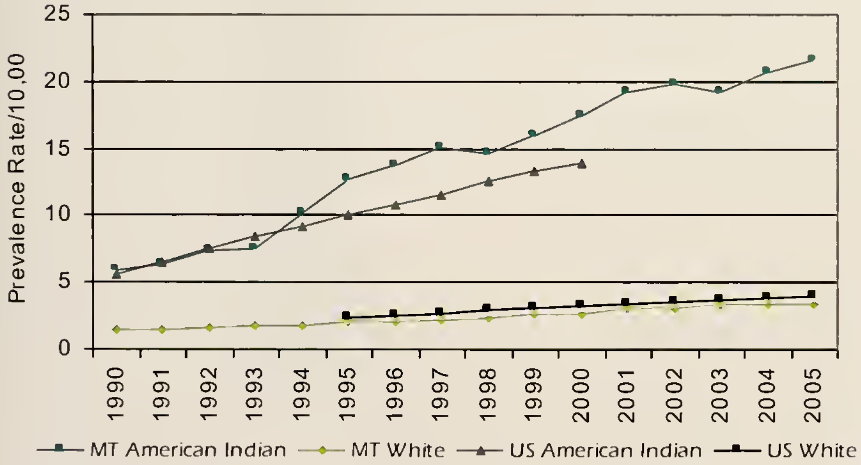
Data source: U.S. Renal Data System, USRDS 2006 Annual Data Report: Atlas of End-Stage Renal Disease in the United States, NIH, NIDDK, Bethesda, MD, 2006

Figure 5-3. Age-adjusted prevalence rates of end-stage renal disease (ESRD) associated with diabetes mellitus, 1990- 2005.



Data source: U.S. Renal Data System, USRDS 2006 Annual Data Report: Atlas of End-Stage Renal Disease in the United States.NIH. NIDDK. Bethesda. MD. 2006.

Figure 5-4. Crude prevalence rates of end-stage renal disease (ESRD) associated with diabetes mellitus by race, Montana and the US, 1990- 2005.



Data source: U.S. Renal Data System, USRDS 2006 Annual Data Report: Atlas of End-Stage Renal Disease in the United States, NIH, NIDDK, Bethesda, MD, 2006.

Race

In 2005, the diabetes-related ESRD prevalence rate in Montana Indians was 7 times the rate of whites in Montana (22 per 10,000 in Montana Indians compared to 3 per 10,000 in Montana whites). The diabetes-related ESRD prevalence rate in Montana whites was nearly identical to that of US whites in 2005 (3 versus 4 per 10,000, respectively). However, the diabetes-associated ESRD prevalence rate in Montana Indians (17 per 10,000) was higher than the overall US American Indian rates (14 per 10,000) in 2000 (the comparable time point) (Figure 5-4). In 2005, Montana Indians contributed 25 percent of all diabetes-related ESRD in Montana. (Data not shown)

In 2005, 25 percent of diabetes-related ESRD in Montana occurred in American Indians

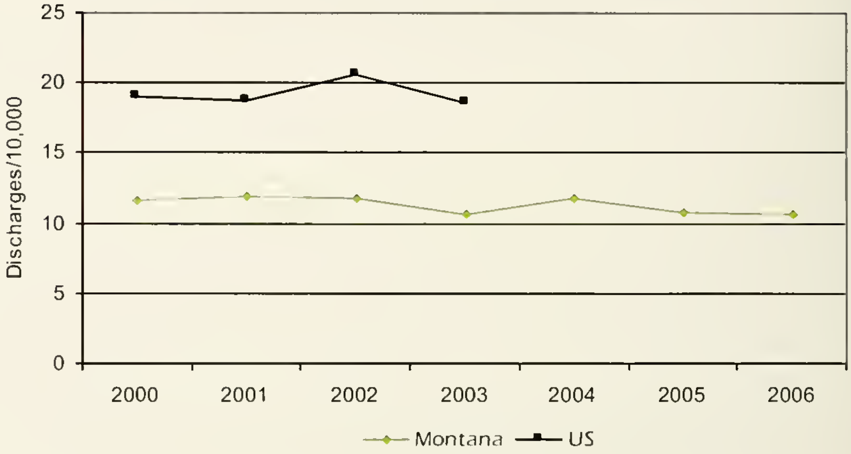
COMPLICATIONS

Cardiovascular disease

The age-adjusted hospital discharge rate for a primary diagnosis of coronary heart disease with a secondary diagnosis of diabetes remained at approximately 11 per 10,000 in Montana from 2000 to 2006. The rate in Montana was lower than the US rate, which remained relatively constant at approximately 19 per 10,000 from 2000 to 2003. (Figure 5-5)

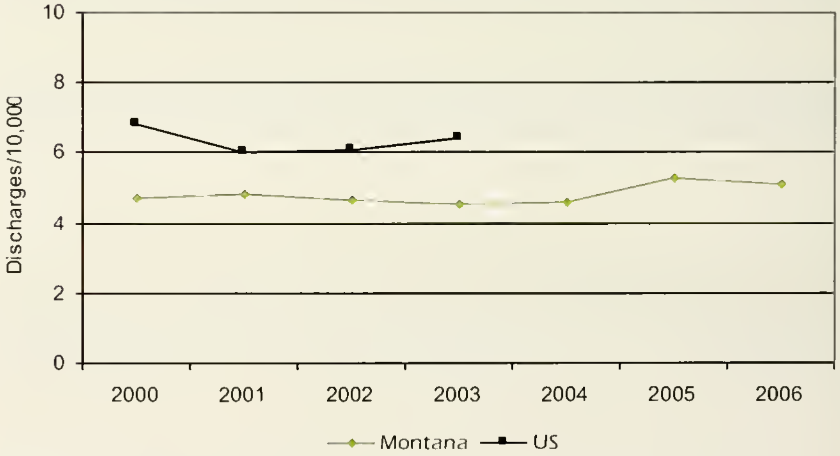
A similar trend was observed for stroke hospital discharges associated with diabetes in Montana. The age-adjusted hospital discharge rate for a primary diagnosis of stroke with a secondary diagnosis of diabetes remained at approximately 5 per 10,000 in Montana from 2000 to 2006, slightly lower that the US rate which remained at about 6 per 10,000 from 2000 to 2003. (Figure 5-6)

Figure 5-5. Age-adjusted hospital discharge rates for coronary heart disease as primary diagnosis and diabetes as any secondary diagnosis, Montana and US, 2000-2006.



Data source: MT: Montana hospital discharge data, Montana Hospital Association, 2000-2006.

Figure 5-6. Age-adjusted hospital discharge rates for stroke as primary diagnosis and diabetes as secondary diagnosis, Montana and US, 2000-2006.

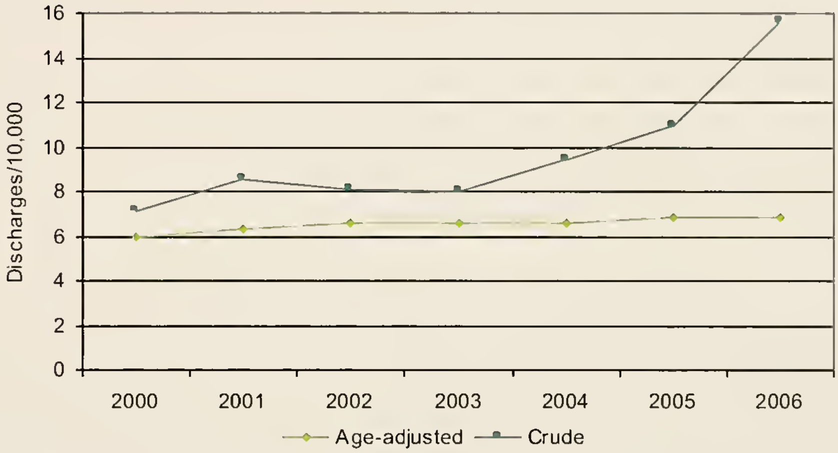


Data source: MT: Montana hospital discharge data, Montana Hospital Association, 2000-2006.

COMPLICATIONS

In 2006, the crude hospital discharge rate for a primary diagnosis of heart failure with a secondary diagnosis of diabetes was 16 per 10,000 in Montana. The crude rate remained at approximately 8 per 10,000 from 2000 to 2003, followed by an exponential increase to the 2006 rate. When this hospital discharge rate was adjusted for age, the trend flattened, increasing slightly from 6 per 10,000 in 2000 to 7 per 10,000 in 2006. Therefore, while there were more hospitalizations for heart failure in 2006 for diabetic adults aged 45 to 64, 65 to 74 and over 75 years, this increase was proportional to the increase in the Montana population for these age groups. (Figure 5-7)

Figure 5-7. Crude and age-adjusted hospital discharge rates for a primary diagnosis of heart failure with any secondary diagnosis of diabetes, Montana 2000-2006



Data source: MT: Montana hospital discharge data, Montana Hospital Association, 2000-2006.

Hyperglycemia accelerates atherosclerosis — increasing risk for cardiovascular disease

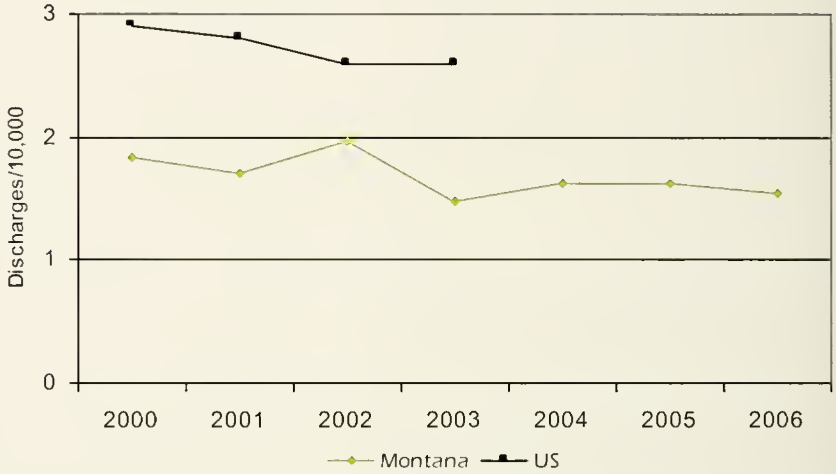
COMPLICATIONS

Lower extremity amputation

The age-adjusted hospital discharge rate for non-traumatic lower extremity amputation with a diabetes diagnosis remained at 2 per 10,000 in Montana from 2000 to 2006. The US rate was similar, remaining at 3 per 10,000 from 2000 to 2003 (Figure 5-8). From 2000 to 2006 in Montana, 66 percent of all discharges with a procedure code for non-traumatic lower extremity also had a diabetes diagnosis listed.

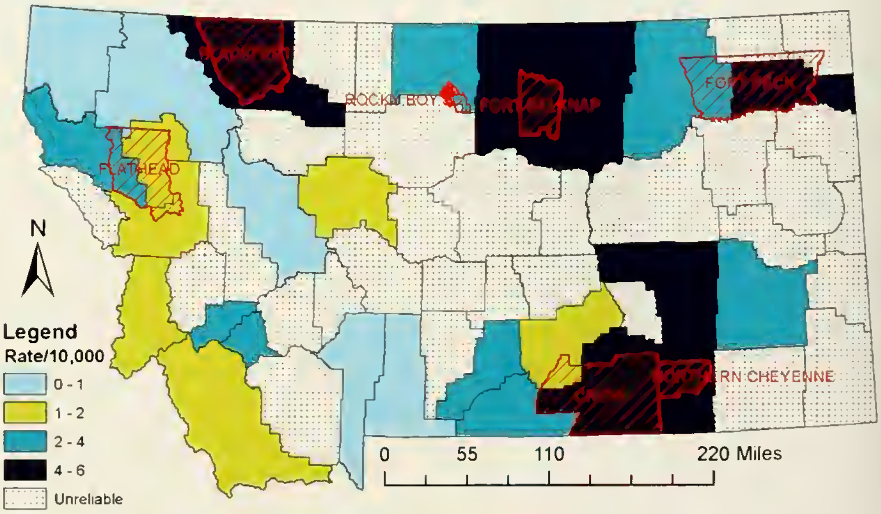
The hospital discharge rate for non-traumatic LEA was markedly higher in counties with a high proportion of American Indians in the population than in counties with a lower proportion of American Indians. The average rate of discharge for LEA with a diabetes diagnosis in counties containing Indian reservations (4 per 10,000) was twice the statewide rate of 2 per 10,000. (Figure 5-9)

Figure 5-8. Age-adjusted hospital discharge rates for lower limb amputations and diabetes as any diagnosis, Montana and US, 2000-2006.



Data source: MT: Montana hospital discharge data, Montana Hospital Association, 2000-2006.

Figure 5-9. Hospital discharge rate for any procedure non-traumatic lower extremity amputation with a diagnosis of diabetes by county, Montana 2000 to 2006.



6

MORTALITY

Information presented in this chapter was obtained from Montana death certificates. Death certificates record only one underlying or principal cause of death, but also contain up to 20 contributing causes of death.[22] These are not mutually exclusive, however; if diabetes is listed as the underlying cause, it is always also listed as a contributing cause.

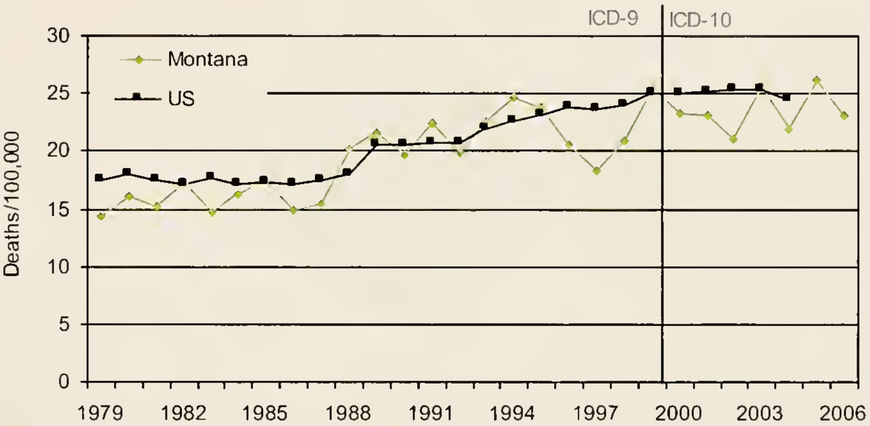
Diabetes as an underlying cause of death

The diabetes mortality rate (diabetes as the underlying cause of death) in Montana was similar to the general US population. For Montanans, the age-adjusted diabetes mortality rate increased from 14 per 100,000 in 1979 to 23 per 100,000 in 2000. Montana rates have remained at approximately 23 per 100,000 since 2000. For the US population, the age-adjusted diabetes mortality rate steadily increased from 17 per 100,000 in 1979 to 25 per 100,000 in 2000. After 2000, the age-adjusted diabetes mortality rate remained constant at approximately 25 per 100,000. (Figure 6-1)

Gender

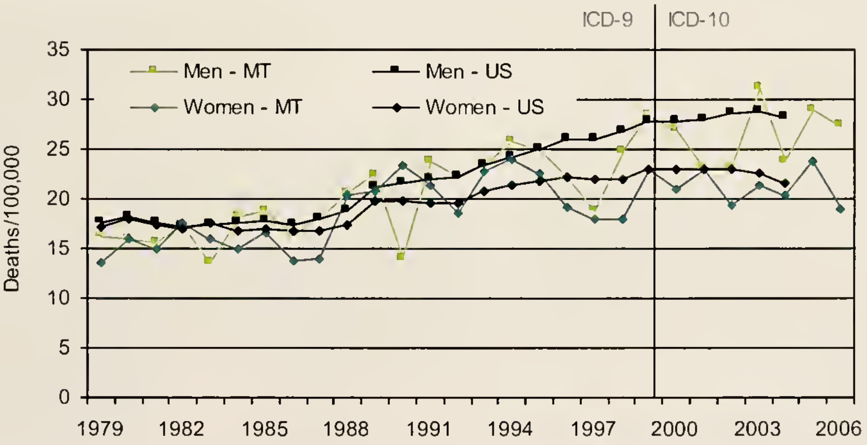
The age-adjusted diabetes mortality rates for US men and US women were similar and remained relatively constant at 17 per 100,000 from 1979 to 1983. After 1983, the age-adjusted diabetes mortality rate for US men increased steadily from 17 per 100,000 to 28 per 100,000 in 2004. For US women, the age-adjusted diabetes mortality rate increased at a slower rate compared to US men from 17 per 100,000 in 1983 to 22 per 100,000 in 2004. The age-adjusted diabetes mor-

Figure 6-1. Age-adjusted diabetes mortality rates for Montana and the general US population, 1979-2006.



MT (1979-1989) and US (1979-2004) data source: Compressed Mortality file, CDC Wonder (accessed: 6/27/07)
Diabetes mortality rates for US not available for 2005
MT (1990-2006) data source: Montana DPHHS, Office of Vital Statistics

Figure 6-2. Age-adjusted diabetes mortality rates for Montana and the general US population, by gender, 1979-2006.



MT (1979-1989) and US (1979-2004) data source: Compressed Mortality file, CDC Wonder (accessed 6/27/07)
Diabetes mortality rates for US not available for 2005
MT (1990-2006) data source: Montana DPHHS, Office of Vital Statistics

tality rates showed similar trends for Montana men and women. Montana men had a higher age-adjusted diabetes mortality rate compared to Montana women after 1983. (Figure 6-2)

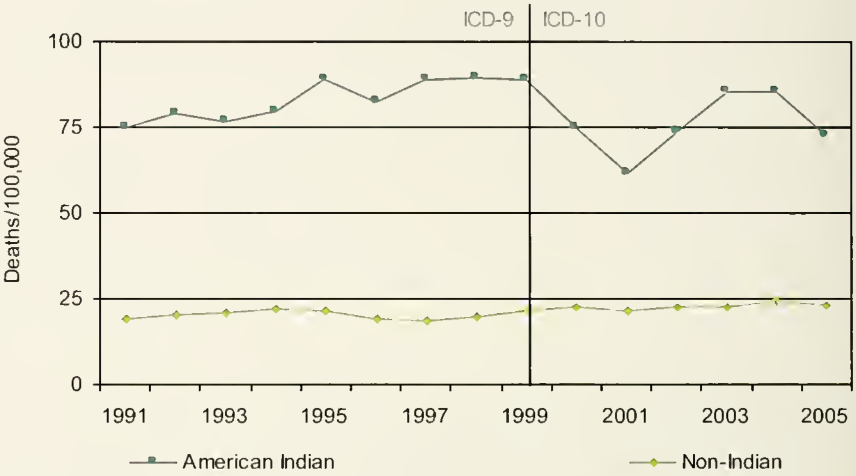
Race

The age-adjusted diabetes mortality rate for Montana Indians was three times higher than the rate of the non-Indian population from 1990-2005. The age adjusted diabetes mortality rate for Montana Indians increased from 75 per 100,000 in 1991 to 85 per 100,000 in 2004. For the non-Indian population, the rate increased slightly from 19 per 100,000 in 1991 to 23 per 100,000 in 2004. (Figure 6-3)

County of Residence

Generally, small urban counties from 2000 to 2006 had lower diabetes mortality rates compared to frontier counties, with the notable exception of Silver-Bow County, which had the highest diabetes mortality rate in Montana.

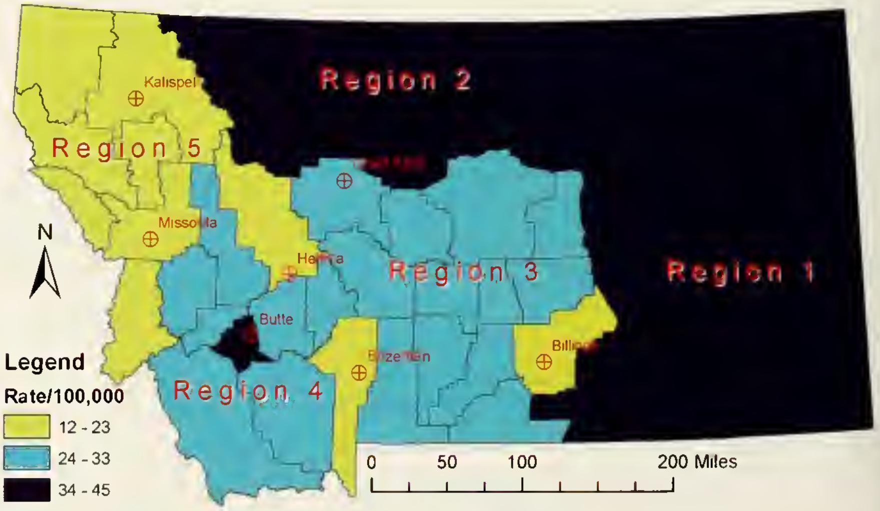
Figure 6-3. Smoothed* age-adjusted diabetes mortality rates, by race, Montana, 1990-2005.



*3-year moving average (i.e., smoothed rate shown for 1991is an average of 1990, 1991, 1992)

Data source: Montana DPHHS, Office of Vital Statistics

Figure 6-4. Diabetes mortality rate by Montana Health Planning Regions and major population centers, 2000-2006.



MORTALITY

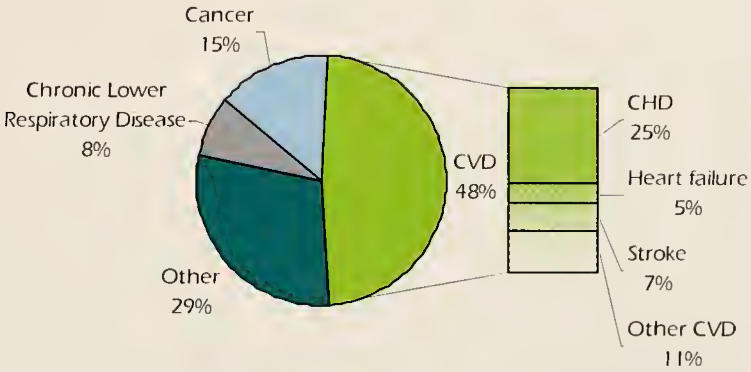
Diabetes as a contributing cause of death

From 2000 to 2006, 1,694 deaths in Montana listed diabetes as the underlying or principal cause of death. An additional 3,138 deaths listed diabetes as a contributing cause (an age-adjusted rate of 43 per 100,000). These 4,832 diabetes-related deaths represented 8.3 percent of all deaths in Montana during that time period. (Data not shown)

From 2000 to 2006, 50 percent of diabetes-related deaths (deaths where diabetes was the underlying cause or a contributing cause) among Montana Indians listed diabetes as the principal cause of death. Just over one third of diabetes-related deaths among Montana whites listed diabetes as the principal cause of death. (Data not shown)

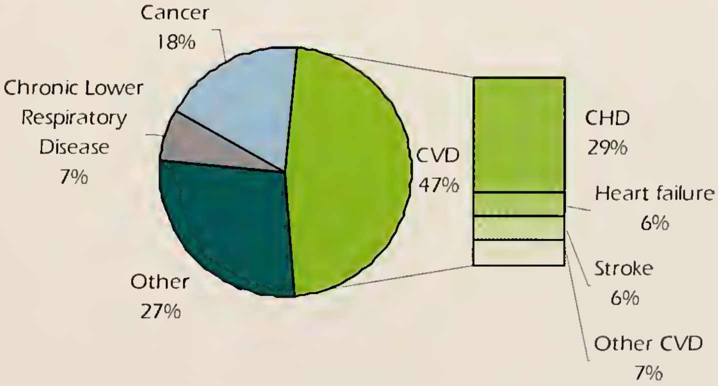
For deaths where diabetes was listed as a contributing cause of death but not listed as the underlying cause of death from 2000 to 2006, the most common underlying cause of death among both whites and Montana Indians was cardiovascular disease; accounting for nearly 50 percent of this subset of diabetes-related deaths. (Figures 6-5 and 6-6)

Figure 6-5. Underlying cause of death where diabetes mellitus is listed as a contributing cause of death and not listed as the underlying cause of death, Montana whites, 2000-2006.*



*Percents are not comparable to underlying cause of death percentages reported at the state or national level.

Figure 6-6. Underlying cause of death where diabetes mellitus is listed as a contributing cause of death and not listed as the underlying cause of death, Montana Indians, 2000-2006.*



*Percents are not comparable to underlying cause of death percentages reported at the state or national level.

DISCUSSION AND CONCLUSIONS

This document describing the burden of diabetes in Montana presents data from several different sources. Each source provides only a partial view of diabetes and its complications in Montana. Progress and challenges can be identified from each data source along with opportunities to address the challenges.

The BRFSS and related telephone surveys demonstrated that diagnosed diabetes has increased across the state with remarkably high rates in the Indian communities. Many more Montanans were at risk for developing diabetes with rising rates of overweight and obesity in adults. Persons with diabetes reported the co-existence of other important risk factors including hypertension and high cholesterol. Many adults who had not been diagnosed with diabetes reported a significant burden of cardiometabolic risk factors. The telephone surveys also measured selected indicators of diabetes care and allowed comparison to trends in the US as a whole. Montana adults with diabetes reported rates of preventive exams and testing that were similar to those reported in the US. However, levels of immunization against influenza and pneuomoccal disease exceeded comparable rates in the US. Montana meets or exceeds Healthy People 2010 goals for 6 of the 7 diabetes care indicators surveyed by BRFSS.

In recent years birth certificates in Montana have included specific information about diabetes in pregnancy. Gestational diabetes has constituted most of the burden of diabetes in pregnancy. Pregnant women older than 30 years of age were at higher risk than younger women. The extent of the disparity among American Indian women emerged from the data. Residence in a frontier county was a risk factor as well as being a Medicaid recipient.

Data from the USRDS showed that almost half the cases of End-Stage Renal Disease (ESRD) in Montana were attributed to diabetes as the cause of renal failure. A quarter of all the ESRD cases in Montana occurred in American Indians. Hospital discharge data showed a puzzling increase in discharge rates for Chronic Kidney Disease and ESRD in those with diabetes since 2004. Two thirds of all non-traumatic lower extremity amputations performed in Montana hospitals occurred in individuals who were diagnosed with diabetes. Hospitalization rates for heart disease and stroke in those with diabetes was lower for Montanans than the general US population.

The diabetes mortality picture derived from death certificates showed that diabetes was coded as a contributing cause of death much more frequently than as the primary or underlying cause. Diabetes was related to 8.3 percent of all deaths in Montana. Diabetes mortality rates in Montana have increased along with the US rates, but the diabetes death rates for men and women in Montana have been somewhat lower than the comparable US rates. In summary, Montana is facing an increasing burden of diabetes with rates, risk factors and mortality rising. The data presented will allow public health officials and health care professionals to identify important opportunities to intervene.

APPENDIX- METHODS, DATA SOURCES AND LIMITATIONS

Analyses were conducted using SAS v9 (SAS Institute, Cary, Indiana), SUDAAN v9 (RTI, Durham, North Carolina), and Microsoft Excel 2003. Maps were generated using ArcMap Geographical Information Software (ESRI, Redlands, California).

County of Residence

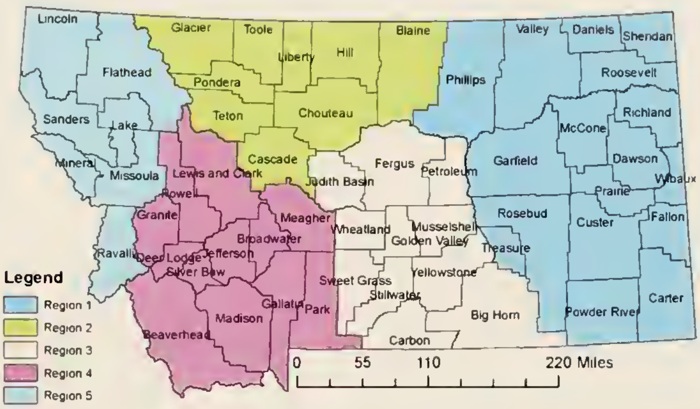
Definitions used for Montana's "small urban" and "frontier" counties were based on the five urbanization levels classification obtained from the Office of Management and Budget as used in Health, United States, 2001 with Urban and Rural Health Chartbook.[8] During the past two decades, Montana's total population did not exceed 1 million people; therefore, we combined small metropolitan counties (of which Montana has two) and non-metropolitan counties with a city of 10,000 or more population (of which Montana has five) into the category we defined as "small urban." The remaining 49 counties, defined as non-metropolitan counties without a city of 10,000 or more population we defined as "frontier." The terms "small urban" and "frontier" are used in this document as general descriptors only.

Health Planning Regions

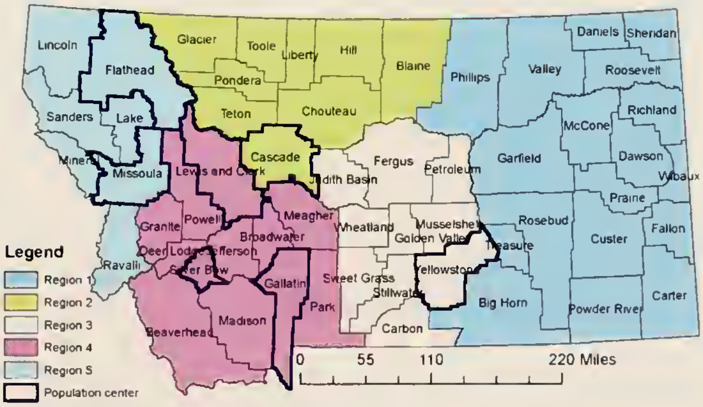
Montana Health Planning Regions are traditionally divided as follows: Region 1 represents eastern Montana and includes Carter, Custer, Daniels, Dawson, Fallon, Garfield, McCone, Phillips, Powder River, Prairie, Richland, Roosevelt, Rosebud, Sheridan, Treasure, Valley and Wibaux counties; Region 2 represents north central Montana including Blaine, Cascade, Chouteau, Glacier, Hill, Liberty, Pondera, Teton, and Toole counties; Region 3 is located near Billings in central Montana including Big Horn, Carbon, Fergus, Golden Valley, Judith Basin, Musselshell, Petroleum, Stillwater, Sweet Grass, Wheatland, and Yellowstone counties; Region 4 represents southwestern Montana including Beaverhead, Broadwater, Deer Lodge, Gallatin, Granite, Jefferson, Lewis & Clark, Madison, Meagher, Park, Powell and Silver Bow counties; Region 5 represents northwestern Montana including Flathead, Lake, Lincoln, Mineral, Missoula, Ravalli and Sanders counties. (Figure A-1)

Because they did not accurately reflect the data at the county level, the Health Planning Regions were modified. Rates in the major population centers are far different from the surrounding rural counties, thus the large population counties of Cascade, Flathead, Gallatin, Lewis & Clark, Missoula, Silver Bow, and Yellowstone were represented individually. Big Horn County had rates vastly different from the rest of Region 3, but was much more similar to Region 1 and therefore was included in Region 1 analysis. (Figure A-2)

A-1. Montana Health Planning Regions



A-2. Modified Montana Health Planning Regions



Behavioral Risk Factor Surveillance System

Information on adult diabetes prevalence, blood pressure, cholesterol, overweight/obesity and diabetes care indicators (diabetes education, daily self-monitoring of blood glucose, annual foot exam, annual eye exam, pneumococcal immunization, and annual influenza vaccination) were obtained from data collected using the Behavioral Risk Factor Surveillance System (BRFSS). The Montana BRFSS is an ongoing state-based, telephone survey to gather information regarding personal practices, attitudes, and knowledge of non-institutionalized adult Montanans (18 years of age and older) that contribute to the leading causes of disease in the state. For Montana, data were weighted to account for differences in probability of selection and to more closely reflect the adult population. For the US population (including District of Columbia), the median of the prevalence was used.

BRFSS questions asked and definitions:

1. Have you ever been told by a doctor that you have diabetes?
2. Have you ever been told by a doctor, nurse or other health professional that you have high blood pressure?
3. Have you ever been told by a doctor, nurse or other health professional that your blood cholesterol is high?
4. Have you ever taken a course or class in how to manage your diabetes yourself?
5. About how often do you check your blood for glucose or sugar?
6. About how many times in the past 12 months has a doctor, nurse, or other health professional checked you for A1c?
7. About how many times in the past 12 months has a health professional checked your feet for any sores or irritations?
8. When was the last time you had an eye exam in which the pupils were dilated?

Respondents who reported pre-diabetes or borderline diabetes were not considered to have diabetes. Female respondents who had been told by a physician or other health professional that they had gestational diabetes or high blood pressure during pregnancy were not considered to have diabetes or high blood pressure.

Limitations:

First, respondents may have a tendency to under-report behaviors that are socially undesirable, unhealthy or illegal (e.g., drinking and driving or smoking), while over-reported information also is affected by the ability or fully recall past behaviors or health screening results. Second, telephone surveys exclude households without telephones (including households where residents use only wireless telephones), which may result in a biased survey population due to under-representation of certain segments of the population. An estimated four percent of Montana households are without telephones and may represent a population segment at high risk of preventable disease associated with low socioeconomic status. The National Health Interview Survey estimated that , in 2007, 14 percent of US household have only wireless telephones.[24] The magnitude of difference between wireless-only and landline telephone owners determines the degree to which disease estimates are effected by this coverage bias.

American Indian adapted Behavioral Risk Factor Surveillance System (AI BRFSS)

The Montana Department of Public Health and Human Services (DPHHS), in collaboration with the Billings Area Indian Health Service, conducted an adapted BRFSS telephone survey of adult American Indians (18 years and older) living on or near Montana's seven reservations in 1999-2005. Trained interviewers made telephone calls to a random sample of households with three-digit telephone prefixes located on or near the seven reservations in Montana. The number of completed telephone calls was proportional to the number of American Indian households on each reservation according to the 2000 census. Persons 18 years of age and older who reported being American Indians were eligible to participate in the survey. Approximately 1,000 surveys of American Indian adults were completed in between 1999 and 2005.

Limitations:

Because the methodology is similar, Montana's AI BRFSS has the same limitations of coverage and recall biases as well as over- and under-reporting of certain behaviors as the statewide BRFSS. Additionally, Montana Indians who do not live on or near the reservations were not included in the survey sample.

Birth certificate data

Montana birth certificates contain check boxes to indicate pregnancies that are affected by gestational or pre-existing diabetes. Prevalence rates of diabetes during pregnancy in Montana were estimated for 1989 to 2006 using Montana birth certificate data. Due to small numbers, three-year periods were concatenated to obtain a sample size large enough for analysis. Maternal age and race were also recorded and the prevalence of diabetes during pregnancy was also estimated by these risk factors. The association between socioeconomic status and diabetes during pregnancy was estimated by linking birth records to Medicaid records. US prevalence rates for 1995 to 2004 was estimated using US birth certificate data available on the CDC WONDER website (http://wonder.cdc.gov/natality.html).

Limitations:

Persons completing the birth certificate do not always correctly indicate pregnancies affected by diabetes. A study in Utah comparing birth certificates to the medical records of women reporting gestational diabetes in the Pregnancy Risk Assessment and Monitoring System (PRAMS) found that 25 percent of gestational diabetes indicated in a medical record was not captured on the birth certificate.[25] Montana birth records likely under-report pregnancies affected by diabetes. Before 2000, birth certificates did not reliably differentiate between gestational and pre-existing diabetes, thus these subgroups cannot be analyzed before this date. As of 2006, Montana birth certificates did not indicate pre-pregnancy weight, thus this important risk factor could not be analyzed.

Death certificate data

All Montana diabetes deaths from 1990 through 2006 were identified through death record information collected by the Office of Vital Statistics (OVS), Montana Department of Health and Human Services. Bureau of Census data were used for 1990 and 2000 population and intercensal population estimates were used for 1991-1999 and 2001– 2006.

Beginning with mortality data for 1999, the Montana OVS began reporting underlying cause of death information by ICD-10 code. Prior to 1999, underlying cause of death information were reported by ICD-9 code. Each new version of the ICD code introduces challenges with the development of comparable mortality data classified with different versions of the code. The National Center for Health Statistics (NCHS) attempts to quantify the effects of ICD revisions for each category of interest by calculating a ration of number of deaths classified in the latest version that classified in the previous version. "Comparibility ratios" provide estimates of change attributed to the revision alone and help distinguish "coding changes" from "real changes." The comparibility ratio for diabetes is 1.0082, thus no correction was performed.

Montana annual mortality rates were calculated from 1990 to 2006 and the rates were age-adjusted to the US 2000 standard population. US mortality data for 1979—2003 and Montana mortality data for 1979 - 1989 were obtained through the use of the NCHS website. US mortality data for 2004 was obtained from the NCHS National Vital Statistics Report. For Montana's American Indian population, an average annual direct age-adjusted (to the US 2000 standard population) rate was calculated for a moving 3-year period from 1990 to 2005.

Records compiled from Montana death certificates list one underlying cause of death and up to 20 contributing causes of death. Underlying cause of death is assigned to the death certificate by a computer algorithm that considers the sequence of events leading up to death as well as information in the "contributing causes" section of the death record. Diabetes mortality was computed for underlying cause of death coded ICD-9 250 or ICD-10 E10-E14. Deaths where diabetes was a contributing cause were computed from a code of ICD-9 250 or ICD-10 E10-E14 in any of the 20 contributing cause of death fields. If diabetes is listed as an underlying cause of death, diabetes is also recorded in one of the 20 contributing cause of death fields.

Limitations:

For a diabetes death to be classified as such, diabetes, either literally or as an ICD code, must be listed on the death record. Several studies have found that in approximately 60 percent of deaths where the decedent was known to have diabetes, diabetes was not listed anywhere on the death certificate. Additionally, the computer algorithm preferentially assigns underlying cause of death to certain conditions (i.e. Alzheimer's disease). Inconsistent and inaccurate race coding for American Indians in death records have been documented. Such findings suggest death rates for Montana American Indians are underestimated overall. The findings also indicate that American Indians who do not live on or near reservations are more likely to be misclassified as non-American Indian at the time of death. Therefore, current available mortality estimates for Montana American Indians who reside outside reservations may be systematically lower than the actual death rate for these persons.

Because Montana's American Indian population had small numbers of diabetes deaths, three years of data needed to be combined to obtain a sufficiently large sample for analysis. Calculating mortality rates over a period of several years may reduce the impact of chance variablility in rates based on small numbers; however, such rates can conceal changes in trends that took place during 1990-2006. With the addition of multi-race as a race category (starting in 2003), the number of deaths listed as American Indians may be decreased, resulting in lower mortality rates. Therefore the mortality rates reported in this document may be an underestimate of the true rate.

Table A-1: ICD-9 codes for diabetes and related complications

	ICD-9 code
Diabetes	250.0—250.9
Chronic kidney disease	250.4, 581.81, 584, 586—588, 590, 55.60—55.69, 39.95, 54.98, 585, V420, V451
End-stage renal disease	55.60—55.69, 39.95, 54.98, 585, V420, V451
Coronary heart disease	410—414, 429.2
Stroke	430—438
Heart failure	428
Non-traumatic lower extremity amputation	84.10—84.18 (exclude: 895.0-897.9)

Hospital discharge data

The Montana hospital discharge data set is maintained by the Montana Hospital Association (MHA). For this report, data from the 2000 to 2006 data sets were analyzed. Data for Montana residents hospitalized in other states were not available and data for non-Montana residents hospitalized with the state were excluded. Diabetes and related complications are defined by primary or secondary diagnosis, and ICD-9 codes are listed in Table A-1. Population estimates used to calculate rates were taken from the National Center for Health Statistics bridged population estimates from 2000 to 2006. Rates were age-adjusted to the US Standard 2000 population.

Limitations:

Reporting for the MHA discharge data includes 65 percent of acute care inpatient hospitals in Montana. Of these hospitals, over 70 percent report 90 percent or more of their discharges. Veterans Administrators, Indian Health Service and state hospitals, as well as a handful of small private hospitals, do not participate in MHA's hospital discharge reporting system. Based on the incompleteness of this data set, hospital discharge rates are likely underestimated. The hospital discharge dataset is based on medical records; the accuracy of physician diagnosis or recording cannot be assessed. The data counts discharges, not individual patients, thus data may have been captured on the same person on multiple occasions. Hospital discharge records did not capture race/ethnicity information, thus discharge rates could not be calculated by race. Payer information was not coded in the same way across sites, thus analysis of this variable is limited in this data set.

United States Renal Disease System (USRDS)

The United States Renal Disease System is a national data system that collects, analyzes and distributes information about end-stage renal disease in the United States. 2005 Montana and US incidence and prevalence of end-stage renal disease and prevalence from 1990 to 2005 was obtained from the USRDS Renal Data Extraction and Referencing (RenDER) System. Population estimates used to calculate rates were taken from the National Center for Health Statistics bridged population estimates from 2000 to 2005. When possible, rates were age-adjusted to the US Standard 2000 population.

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